Sydow,[3] with some assistance from P. A. Saccardo, G. Lindau, and P. Hennings, to whom acknowledgment is made in the preface. The work is brought down to the end of the year 1897.

The type is good, and the spacing ample, so that the volume can be consulted with readiness and comfort. The host species are arranged in a single alphabet, following the authority of the *Index Kewensis*, with the fungi associated with each species named immediately beneath.

The attempt has been made to use but one name for each species of host and of fungus, thus omitting synonyms. The imperfections in the literature of the fungi have made it especially difficult to follow out the plan with the desired success. It is easy to point out names that should have been omitted, as they are clearly synonyms, and to mention others that should have been included. But such shortcomings are incident to the subject, and only emphasize the necessity for early monographic work.

To anyone determining parasitic fungi the volume will prove of the greatest service, and, in connection with the descriptive part of the great *Sylloge*, will be especially welcome.— J. C. A.

What is "vital energy?"

THE PROBLEM before the physiologist is the nature of living matter. Anything that contributes to a solution of this problem is welcome. Dr. Oscar Loew has already done much to make possible a better understanding of the chemistry of protoplasm and its products. In a work published in London in 1896 entitled *The energy of living protoplasm*, he set forth in English the views which now find a more complete exposition in German under the title, *The chemical energy of living cells*.[4] As the former work was not received by the GAZETTE for review, a somewhat extended résumé of his views may now be useful.

After giving a historical summary of previous views as to the causes of vital activity, he avers that the *primum movens* of the living cell is to be sought neither in heat nor electricity, but in a specific chemical activity, viz., the assumption of oxygen by the living substance. The main question, then is, "What conditions lead to the activity of cell respiration and to the transformation of the heat thereby produced into the chemical energy of the living cells?"

The living protoplasm, "at once artificer, work-shop, and plastic material,"

[3] SYDOW, P.—Sylloge fungorum omnium hucusque cognitorum digessit P. A. Saccardo, Vol. XIII; Index universalis et locupletissimus nominum plantarum hospitum specierumque omnium fungorum has incolentium quæ usque ad finem anni 1897 innotuerunt. Roy. 8vo, pp. vi + 1340. Berolini: Fratres Borntraeger, 1898.

[4] LOEW, OSCAR: Die chemische Energie der lebenden Zellen. 8vo. pp. xii + 175. München: Dr. E. Wolff. 1899. *M* 5; geb. *M* 6.

as Hanstein well says, is declared by Loew to be no variable mixture of proteids (as Reinke, Verworn, Pfeffer, and others hold), but organized proteid, whose vital energy depends on its chemical character, as its vital functions depend on its organization. Dead protoplasm and living protoplasm are chemically different; the former is chemically stable while the latter is chemically active or labile, *i. e.*, possessing much kinetic chemical energy, it enters into reaction very readily. Death is the transformation from the labile to the stable form of proteid, by the displacement of certain atoms in the molecule. A labile proteid sometimes occurs as a reserve substance in plants. This is the material whose reaction with silver salts in weak ammoniacal solution was discovered by Loew and Bokorny and was thought to be the reaction of living protoplasm.

With the proteid are combined certain salts of sodium, calcium, magnesium, and iron oxid, and phosphoric acid. The rôle of these materials is discussed, and their importance in the chemical processes pointed out.

After enumerating the biochemical work, and discussing the nature of catalytic processes at some length, two chapters are devoted to the formation of proteids in fungi and in green plants. In another are explained clearly the author's well-known views that labile proteids arise in the higher plants from formaldehyde and ammonia, by way of the aldehyde of asparaginic acid. Thus:

$$\underset{\text{Formaldehyde}}{4\,CH_2O} + \underset{\text{Ammonia}}{NH_3} = \left.\begin{array}{l} CHO \\ CH\,.\,NH_2 + H_2O \\ CH_2 \\ CHO \end{array}\right\}\ \text{Aldehyde of asparaginic acid}$$

$$\underset{\text{Aldehyde of asparaginic acid}}{3\,C_4H_7NO_2} = \underset{\text{An intermediate product}}{C_{12}H_{17}N_3O_4} + 2\,H_2O$$

$$\underset{\text{Intermediate product}}{6\,C_{12}H_{17}N_3O_4} + 12H + H_2S = \underset{\text{Lieberkühn's proteid formula}}{C_{72}H_{112}N_{18}SO_2} + 2H_2O$$

Of course, in the absence of any definite knowledge of the molecular weight of proteid or its exact composition, it is evident that these details can only be theoretical; nevertheless the theory may prove highly useful.

The ninth and tenth chapters (written in collaboration with Th. Borkorny) discuss the labile proteid which they found as a reserve material, its chemical characteristics, and its relation to living proteid.

In the eleventh chapter the author seeks to show upon what the lability (and consequent activity) of the protoplasm depends. It is probably due, he says, to the simultaneous presence in the molecule of aldehyde (CHO) and amido (NH_2) groups; that is, the proteids of living protoplasm are amido-aldehydes, which at death lose their aldehyde groups wholly and the amido groups in large part. Recalling the dictum of Sachs, "The dead organism is dead simply because it has lost its irritability," one may well couple with it the dictum of Loew, "No irritability without lability."

The concluding chapters are devoted to the presentation of a theory

of respiration which may be called the catalytic theory. Loew holds that contact with the living proteid, whose intense kinetic energy is predicated, so increases the lability of the CHOH groups in sugars and of the CH_2 groups in the fatty and amido acids that combination with free oxygen follows, to such an extent that these substances are totally oxidized. In the course of this oxidation, the O_2 is split up into its atoms, but not before. By the energy thus set free as heat, appropriate substances may be raised to the labile condition, and other work done. The protoplasm, in rendering the foods labile, suffers a loss of energy, but this loss is again covered by the energy set free in the oxidation. If free O is wanting, the sugar breaks up into other products (fats, lactic acid, etc.), constituting intramolecular respiration. Loew combats vigorously the accepted idea of a continuous dissociation and regeneration of living substance, holding that the impairment involved would be more likely to result in death than in life. For, if the amount of thermogenous foods in a cell becomes considerably diminished, the lability of the plasma proteid leads to its own direct assumption of oxygen; and when only a small part of the proteid has been altered by oxidation, disorganization follows; that is, death by hunger.

The theory of vital energy thus set forth is a consistent one, and is supported by many strong arguments from the chemical side. It is, of course, diametrically opposed to the view which Pflüger and many other physiologists hold, that lability of protoplasm is due to the presence of cyanogen groups (CN), and that respiration is the oxidation of protoplasm itself, at which climax of chemical power it decomposes continuously, to be as continuously rebuilt out of available foods.

There are difficulties in both theories, and physiologists will do well to read and ponder this clear and interesting book by Dr. Loew.—C. R. B.

NOTES FOR STUDENTS.

M. EDMOND GAIN has endeavored to determine whether the material known as *alinite*, which is recommended for increasing the fertility of the soil through the activity of bacteria, was efficient for this purpose. The active microbe of this product is *Bacillus Ellenbachensis* α (*B. Megatherium* DeBary). His experiments, though not numerous enough to determine the question satisfactorily, indicate that "the addition of alinite produces a beneficial effect, which manifests itself in greater vegetative development of the plants [buckwheat and flax], and in a larger crop of seeds."[5]—C. R. B.

PURIEWITSCH has determined that the splitting of most glucosides by fungi is accomplished extracellularly, through the splitting action of emulsin, into glucose and benzene derivatives.[6] This action is carried on both by

[5] Revue gén. de Botanique **11**: 18–28. 1899.

[6] Berichte der deutsch. bot Gesells. **16**: 368. 1898.